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THE ROLE OF FUEL BRIQUETTES FROM BIOMASS PYROLYSIS PRODUCTS IN THE ENERGY POTENTIAL OF UZBEKISTAN

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Abstract. *The relevance of the study is the effective use of biomass. The biomass potential of Uzbekistan, the formation of a large raw material base for the production of alternative fuel briquettes from local pyrolysis products, is studied. The method of biomass processing is pyrolysis, which is accompanied by exothermic reactions. Information is provided on the future prospects of renewable energy sources, the economic and environmental advantages of fuel briquettes. Conclusions and proposals are made on the contribution of replacing natural fuels with alternative fuel briquettes to reducing the country's air pollution emissions, saving resources, and increasing energy security in local communities.*
Keywords: *Biomass, fuel, briquette, pyrolysis, energy, biocomponents, resource, biofuel.*

РОЛЬ ТОПЛИВНЫХ БРИКЕТОВ ИЗ ПРОДУКТОВ ПИРОЛИЗА БИОМАССЫ В ЭНЕРГЕТИЧЕСКОМ ПОТЕНЦИАЛЕ УЗБЕКИСТАНА

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Аннотация. *Актуальность исследования заключается в эффективном использовании биомассы. Изучен потенциал биомассы Узбекистана, формирование крупной сырьевой базы для производства альтернативных топливных брикетов из местных продуктов пиролиза. Метод переработки биомассы - пиролиз, который сопровождается экзотермическими реакциями. Приведена информация о дальнейших перспективах возобновляемых источников энергии, экономических и экологических преимуществах топливных брикетов. Сделаны выводы и предложения о вкладе замены природных видов топлива на альтернативные топливные брикеты в снижение выбросов загрязняющих веществ в атмосферу страны, экономию ресурсов, повышение энергетической безопасности местных сообществ.*
Ключевые слова: *Биомасса, топливо, брикет, пиролиз, энергия, биокомпоненты, ресурс, биотопливо.*

BIOMASSA PIROLIZI MAHSULOTLARIDAN OLINADIGAN YOQILG'I BRIKETLARINING O'ZBEKISTON ENERGETIKA SALOHIYATIDAGI O'RNI

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Annotatsiya. *Tadqiqotning dolzarbligi biomassadan samarali foydalanish. O'zbekistonning biomassa salohiyati, mahalliy piroliz mahsulotlaridan muqobil yoqilg'i briketlarini ishlab chiqarish uchun katta xom ashyo bazasini tashkil etishi to'g'risida tadqiqotlar o'rganilgan. Biomassani qayta ishlashning usuli piroliz bo'lib, u ekzotermik reaksiyalar bilan birga keladi. Qayta tiklanadigan energiya manbalarining kelajakdagi istiqbollari, yoqilg'i briketlarining iqtisodiy va ekologik afzalliklari haqida ma'lumotlar keltirilgan. Tabiiy yoqilg'ilar o'rniga muqobil yoqilg'i briketlariga almashtirish orqali, mamlakat havosini ifloslantiruvchi moddalar emissiyasini kamaytirishga hissa qo'shishi, resurslarni tejash, mahalliy hamjamiyatlarda energiya xavfsizligini oshirishda xulosa va takliflar keltirilgan.*

Kalit so'zlar: *Biomassa, yoqilg'i, briket, piroliz, energetika, biokomponentlar, resurs, bioyoqilg'i.*

Introduction. The production of briquettes from local biomass pyrolysis products in Uzbekistan is an emerging sector aimed at transforming the country's abundant agricultural and waste resources into sustainable energy solutions. As a nation with significant biomass potential, primarily from its extensive agricultural activities, Uzbekistan is poised to leverage this resource for energy production and environmental sustainability. In 2024, this initiative is expected to play a crucial role in addressing the country's energy demands while simultaneously promoting waste management and reducing greenhouse gas emissions [1,2].

Biomass feedstocks in Uzbekistan, such as cotton stalks, agricultural residues, and livestock waste, offer substantial raw materials for briquette production. The pyrolysis process, which thermally decomposes organic matter in the absence of oxygen, generates valuable products including bio-oil and biochar, which can be further processed into briquettes. This conversion not only helps in managing waste but also provides an alternative fuel source that is more eco-friendly than traditional fossil fuels [3,4]. The transition towards briquette production aligns with Uzbekistan's commitment to increasing the share of renewable energy in its energy mix, aiming for 20% by 2025 [5,6]. Furthermore, while the production of briquettes presents numerous environmental benefits, such as reduced waste accumulation and lower carbon emissions, it also requires careful resource management to prevent ecological harm and ensure long-term viability [2].

Overall, the production of briquettes from local biomass pyrolysis products signifies a promising advancement in Uzbekistan's energy landscape, with the potential to bolster economic development, create jobs in rural areas, and support the global shift towards renewable energy solutions. As this industry develops, it may also enhance local energy security and contribute to the country's socio-economic goals. Additionally, the country generates about 100 million cubic meters of agricultural waste annually, which also contributes to its biomass potential [1,5].

Analysis of literature of the topic. The livestock sector in Uzbekistan is another critical contributor to biomass resources, with over 9 million head of cattle and 15 million sheep and goats producing significant amounts of organic waste—exceeding 100 million cubic meters per year. This waste can be utilized in biogas production processes, leading to the generation of renewable energy and high-quality organic fertilizers [1,2]. The theoretical potential for biogas production from livestock waste alone is estimated to be capable of replacing 6.4 billion cubic meters of natural gas annually, underscoring the sector's importance for energy self-sufficiency in rural areas [1,5].

Municipal solid waste (MSW) also represents a substantial biomass resource, with an estimated generation of around 30 million cubic meters per year [1]. This waste consists of various organic materials, such as food scraps and yard waste, which can be converted into biogas through anaerobic digestion or composting processes, further enhancing Uzbekistan's biomass energy potential [2].

The total technical potential of biomass in Uzbekistan is estimated at 3,500 MWh, with available biomass resources capable of meeting 10% of the country's energy demand [1]. Despite

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these promising figures, further research is necessary to accurately assess the energy potential of different biomass feedstocks and optimize their utilization in energy production and sustainable practices.

A promising method of biomass processing is pyrolysis, which is accompanied by exothermic reactions [6].

Pyrolysis is a thermochemical process that involves the decomposition of organic materials, such as biomass, plastics, and rubber, at elevated temperatures in the absence of oxygen. This process typically occurs at temperatures ranging from 400 to 600°C and produces three primary products: bio-oil, biochar, and syngas, with thespecific composition of these products influenced by variables such as temperature, pressure, and the feedstock's characteristics [5].

The pyrolysis process is recognized for its economic and environmental advantages. It enables the conversion of renewable resources and waste materials, such as agricultural residues and forestry by-products, into valuable energy sources, thereby supporting sustainable waste management practices. Additionally, the process contributes to carbon neutrality by recycling organic materials and reducing green house gas emissions [3].

Recent studies, such as those conducted in Uzbekistan, have focused on determining optimum conditions for producing biomass briquettes. For instance, a screw-type briquette press was utilized, allowing for controlled temperature operations to mold briquettes in a single step, which streamlines the production process [3]. The research explored various temperature settings and raw material combinations, such as bagasse and cassava flour, to optimize briquette fuel properties [3].

Briquettes produced from local biomass are increasingly used for various applications, including heating and cooking in households and as fuel in industrial settings. Their high energy density and low emissions compared to traditional fuels make them a cost-effective and eco-friendly alternative [4]. Additionally, efficient briquette manufacturing contributes to resource conservation, waste management, and rural development, enhancing job creation and energy security within local communities [5].

The production of briquettes from local biomass pyrolysis products presents several environmental advantages. By utilizing agricultural and forestry waste, which are abundant in Uzbekistan, briquette production helps to mitigate the accumulation of industrial and agricultural waste, thereby reducing environmental pollution and the burden on landfills. The thermochemical conversion of biomass through pyrolysis produces valuable products such as biochar and syngas, which have the potential to lower greenhouse gas emissions when used as alternative fuel sources [2]. By replacing traditional fossil fuels with briquettes, the country can contribute to a reduction in air pollutant emissions, addressing the pressing challenges of climate change and air quality degradation [4]. Moreover, briquettes have a lower carbon footprint compared to conventional fuels, further supporting sustainable energy solutions.

Materials and methods. The promotion of briquette manufacturing aligns with Uzbekistan's broader socio-economic goals, including energy security, rural development, and job creation. By reducing reliance on imported fossil fuels and traditional biomass, briquettes can help stabilize energy prices and enhance community resilience against fluctuations in global fuel markets [2]. Additionally, the expansion of briquette production has the potential to contribute to local economies by providing entrepreneurial opportunities and fostering sustainable development initiatives [3].

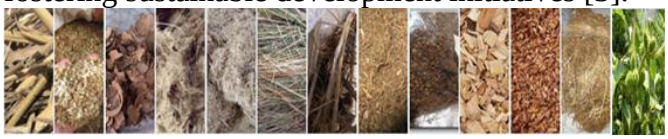

Figure 1. Raw materials and supplies for fuel briquettes from local biomass.

Research conducted at the Karshi Institute of Engineering and Economics has extensively studied cost-effective heating methods for greenhouses and alternative energy sources in areas where energy is not available. The pyrolysis plant has been used to produce alternative fuels for greenhouse heating systems from biomass and various local organic waste [6].

The “pyrolysis reactor-heat generator” device created by the researchers allowed the production of 100-120 m3 of biogas fuel by processing up to 600 kg of biomass (cattle manure, plant waste, etc.) per

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day [15].

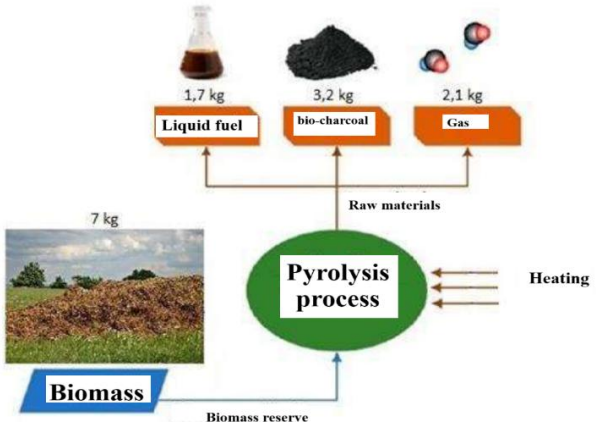

Figure 2. Product balance of the biomass pyrolysis process.

It is possible to obtain not only thermal energy from biomass, but also electrical energy. In this case, the use of cogeneration units is certainly a promising solution. This is because in the electricity industry, burning pyrolysis gas in an engine is more efficient than biogas. According to sources from world scientists, 0.29-0.31 m3 of pyrolysis gas or 0.36-0.38 m3 of biogas is required to produce 1 kW of electricity. When we analyze the composition of pyrolysis gas, we can see that methane is the main gas. The diagram below shows the composition of pyrolysis gas (Figure3).

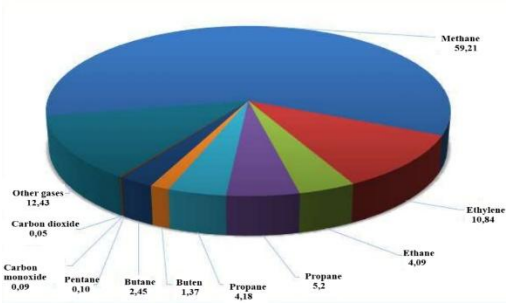

Figure 3. Composition of pyrolysis gas.

Discussion. In the case of Uzbekistan, we can take one of the localized weeds, the saltwort plant. We can obtain pyrolysis products from this plant and, by adding biomass of various compositions to it, create a new local alternative fuel using briquetting technologies. The saltwort plant is found in almost all regions of Uzbekistan. It is important to study the energy efficiency of a device for preparing alternative fuel briquettes based on local biomass pyrolysis products and to determine the heat of combustion of fuels.

Conclusion. In this article, I proposed the development of alternative fuel briquettes based on local biomass pyrolysis products and biocomponents generated using a pyrolysis device. An unconventional type of fuel significantly satisfies the needs of the population for fuel. It is also of practical importance in solving the problem of uninterrupted fuel supply to rural settlements and greenhouses located far from centralized energy supply. At the same time, it can make a positive contribution to the local economy.

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